

COMPARISON OF THE EFFECTS OF THREE DIFFERENT DEHORNING TECHNIQUES
ON BEHAVIOR AND WOUND HEALING IN FEEDER CATTLE IN A WESTERN KANSAS
FEEDLOT.

by

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Abstract

Cross-bred horned steers and heifers ($n = 40$; $BW = 311.8 \pm 4.7$ kgs.) were used to determine the effect of dehorning methods on pain, cattle behavior and wound healing. Cattle were blocked by weight and randomly assigned to 1 of 4 treatments: 1) control (CON); 2) banded using high tension elastic rubber (BAND); 3) mechanically removed (MECH); or 4) tipped (TIP). Vocalization and behavior were recorded during the dehorning process. Wound healing scores, attitude, gait and posture, appetite, and lying were recorded daily. Data were analyzed using the Wilcoxon Rank Sum Test of SAS (Cary, NC). Vocalization scores were highest for MECH, and the BAND cattle vocalized more than TIP and CON ($P < 0.05$). There were treatment effects for gait and posture ($P = 0.03$), appetite ($P = 0.01$) and lying scores ($P < 0.01$), BAND cattle had higher scores ($P < 0.10$) in these parameters compared to MECH, TIP and CON cattle. There was treatment by time interactions for attitude ($P < 0.01$), horn bud ($P < 0.01$) and bleeding ($P < 0.01$). BAND cattle had increased attitude scores in weeks 1, 3 and 4 ($P < 0.10$), increased hornbud scores in weeks 3 and 4 ($P < 0.05$) and increased bleeding scores in week 3 ($P < 0.05$). These data indicate that MECH is a painful procedure for cattle at the time of the procedure. Banding to remove horns from cattle is not recommended based on the data and observations from this study.

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Dedication

I dedicate this work to both of my late grandfathers, W. Glen Neely and Jack McClaskey, both of whom were and continue to be great influences in my life. They were both servicemen to our country and agriculturalists who had great respect and love for the land.

Chapter 1 - Literature Review

Introduction

Dehorning is an animal husbandry procedure that is implemented in many dairy and beef cattle production systems every day. The procedure of dehorning is the partial or entire removal of the cornified epithelial tissue and the frontal bone core of the horn (AVMA 2011). Dehorning can be done by several different techniques including chemically, amputation, cauterization or a combination of the aforementioned techniques (AVMA 2011). Cattle can be dehorned during various stages in the production system be it either when the calves are a few months old, at weaning or when they are received into feedyards. It is generally preferred that the dehorning is done when the calves are less of four weeks of age, when the procedure is less traumatizing and painful (Duffield 2008). Dehorning is utilized in production systems for a variety of reasons including cattle handling safety for the animal handlers, easier capture and handling in chutes (Faulkner and Weary 2000 and Garry 2004) decrease carcass bruising and waste (Ramsay et al. 1976 and Marshall 1977), increased feeder price (Barham 2007) and packer demands (Smith 1996).

Anatomy

Klaus-Dieter Budras describes the anatomy of the bovine horn, associated vasculature and neurology in a chapter of *Bovine Anatomy: An Illustrated Text*, 2003. Bovine horns or cornua are bony projections that arise from the frontal bones of the skull. The skin covering the horn is unique in that the periosteum is fused with the dermis and there is no subcutis layer (Klaus-Dieter Budras 2003). The epidermal layer produces the hard stratum corneum that incases

the bone making a sheath of cornified tissue (Klaus-Dieter Budras 2003). At birth the part of the horn that will develop into the osseous core is a thickened in the cutaneous layer, as the animal grows this soft tissue core becomes ossified and at six months it will develop a pneumatic core that communicates with the frontal sinus (Klaus-Dieter Budras 2003). At the base of the horn where the epithelium transitions from being cornified to being haired skin is comparable to periople of the hoof and is called the epikeras (Klaus-Dieter Budras 2003). The text goes on to describe the layers of new cornified epithelial cells are produced in an longitudinal fashion underneath the top layer of the cornified sheath, thus allowing the horn to grow in length and causing the cornified sheath to be thicker at the apex of the horn and thinner at the base. The blood supply to the horn is the cornual artery and vein from the superficial temporal artery and vein branches and the lymph vessels in the area of the horn drain to parotid lymph node (Klaus-Dieter Budras 2003). The primary sensory innervation of the area around the horn is provided by the cornual nerve of zygomaticotemporal branch of the maxillary branch of the trigeminal nerve. Some sensory innervation is supplied by the supraorbital and infratrochlear nerve, which are both branches of the ophthalmic branch of the trigeminal nerve (Klaus-Dieter Budras 2003 and AVMA 2011).

Techniques

There are several ways to effectively dehorn cattle; the preferred technique usually depends on the age of the animal and the size of the horn. In young calves, predominantly on dairy farms, the most popular techniques use caustic paste or hot-iron dehorning. The caustic dehorning technique is done before the horn buds are fused to the frontal bones of the skull, which is typically when the calf is less than 8 weeks of age, the active ingredients in the paste is usually calcium hydroxide and sodium hydroxide and the paste is rubbed in an even coating on

the horn bud with a diameter of 2 cm (Vickers 2005). The hot iron technique or cautery disbudding is used on young calves normally less than six weeks of age. This technique uses a hot iron that is concave shaped (either electric or heated by flame) to destroy the germinal epithelial tissue that surrounds the base of the corneal tissue (Stafford 2009). If the iron does not destroy all the surrounding germinal tissue there will be regrowth of the horn in a deformed matter (Stafford 2009). A 2005 Canadian study compared the dehorning treatments of hot iron dehorning versus caustic dehorning. Caustic paste used with sedation is less painful than hot iron dehorning used sedation and local anesthesia (Vickers 2005). The caustic paste treatment resulted in less head shaking and rubbing over a 12 hour period.

There has also been research completed on the arresting of horn growth in dairy calves less than a month of age using cryosurgery (Bengtsson, 1996). This technique while being efficacious is very limited in a field setting due to the amount of time it takes complete the procedure, which was approximately ten minutes, and it still causes enough pain that analgesia and sedation may be indicated (Bengtsson, 1996).

Amputation dehorning is the method used when the horn bud is solidly attached to the frontal bone. The technique is completed by the entire removal of the keratinized horn proximal to the epikeras or the germinal tissue layer (Klaus-Dieter Budras 2003, AVMA 2011). There are several different surgical instruments that can be used for this procedure including scoops, saws, guillotine and embryotomy wire (Sylvester 2004). The different instruments result in different wounds. Typically a scoop dehorner (Fig. 1-1) will result in a deeper concave wound that results in a smaller wound in diameter, but greater in depth, and it is used on cattle with smaller horns. A guillotine shear (Fig. 1-2) is used typically on heavier cattle with larger horns and it results in a wound with a larger surface area, but a shallower in depth (Stafford 2009).

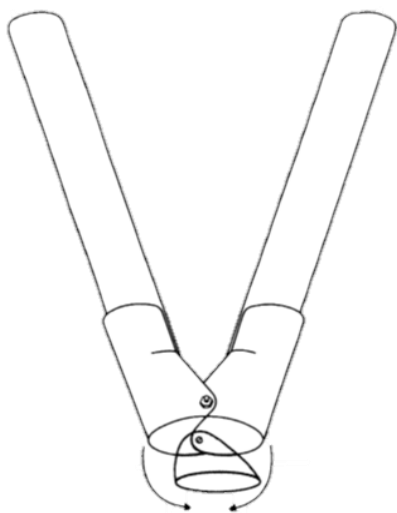


Figure 1-1, Scoop Dehorner (Stafford 2009)

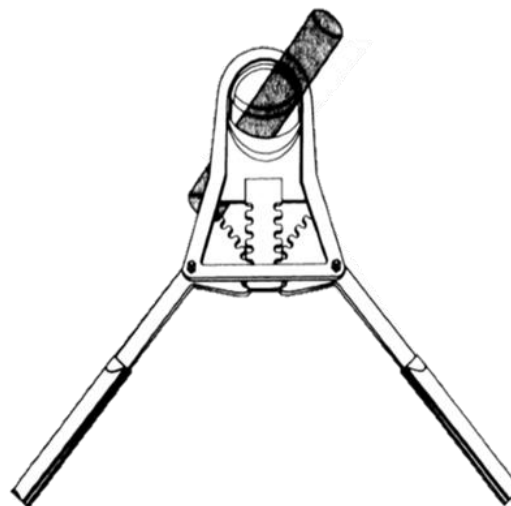


Figure 1-1, Guillotine (Stafford 2009)

Complications can arise in calf health due the opening of the frontal sinus (Stafford 2009), potentially exposing it to the development of infection as it is typically left to heal by second intention (Kihurani 1989). The exposed tissue is vulnerable to fly strike and screw worm infestation during the warm summer months, thus fly control and medical treatments of these wounds can be of great importance (Stafford 2009). Also in cattle with an opening of the frontal sinus there comes the risk of foreign material such as feces and dirt that enters into the sinus and causes a sinusitis that may result in the need for trephination for drainage of the purulent discharge (Stafford 2009). There is also the potential for spreading of disease by the contamination of the dehorning equipment. Studies have shown the potential for bovine leukosis virus (BLV) to be spread by gouge dehorning (AVMA 2011). Bovine cutaneous papillomas can also be spread by viral transmission on contaminated dehorning equipment (AVMA 2011). The biggest concern initially with amputation dehorning is hemorrhage from the wound. Bleeding is

sometimes electively controlled by pulling exposed blood vessels, cauterizing, hemostatic powder or tourniquet (Stafford 2009)

Another technique is the method of tipping the horns. It only involves removing the tip of the keratinized horn. Removing the tip of the horn can vary from just the tip to reducing the length of the horn to half the length of the ear in mature cattle (Wythes 1979). The goal of the procedure is to not take the tip of the horn deep enough to enter into the pain sensitive core (Fig. 1-3) (Stafford 2009).



Figure 1-2, Tipping ✓ = Correct Location, X = Incorrect Location. (Stafford 2009)

Banding is a method that has been described more recently on internet forums and there is no research currently to evaluate its efficacy or pain effects. Banding is completed by the use of high tension rubber to dehorn cattle by avascular necrosis. The Callicrate Bander™ is an instrument that is used commonly in this process. The Callicrate Bander™ website www.nobull.net has a page that outlines the procedure of how to use the bander to dehorn cattle. The instructions call for placing the band below the keratinized tissue of the horn and as close as possible to the head (Callicrate). It also notes that some producers will place duct tape over the

band to protect it from being rubbed off by the calf. The website makes note that the producer should expect smaller diameter horns to fall off in 20 to 30 days, and it may take larger horns up to 50 days to fall off (Callicrate).

Pain Evaluation

There have been many routes that have been taken in an attempt to evaluate pain responses due to dehorning. It is difficult to evaluate pain responses in cattle because as a prey species they have an enhanced ability to mask pain (Stafford 2009). In past research data has been collected on serum cortisol levels, heart rate, acute phase proteins and interferon- γ production (Baldrige 2011). Other ways of potentially evaluating the pain response are average daily gain, behavioral scores, feed intake, activity in the chute and vocalization (Baldrige 2011). In a New Zealand review paper published in 2005 it was noted that the two most popular ways for evaluating pain responses due to dehorning procedures was using plasma cortisol levels and changes in behavior (Stafford 2005).

Plasma cortisol level is one of the most popular ways to collect quantitative data in an attempt to assess pain responses in cattle. In studies it has been shown that with dehorning procedures such as caustic paste (Stilwell 2008), cauterization (Faulkner 2000, Graf 1999, Grondahl-Nielsen 1999) and amputation (Sylvester 1998, Sutherland 2013) plasma cortisol levels will be elevated to a peak post procedure, decline to a plateau and drop back to base line after about eight hours (Fig. 1-4) (Stafford 2005, Stafford 2009).

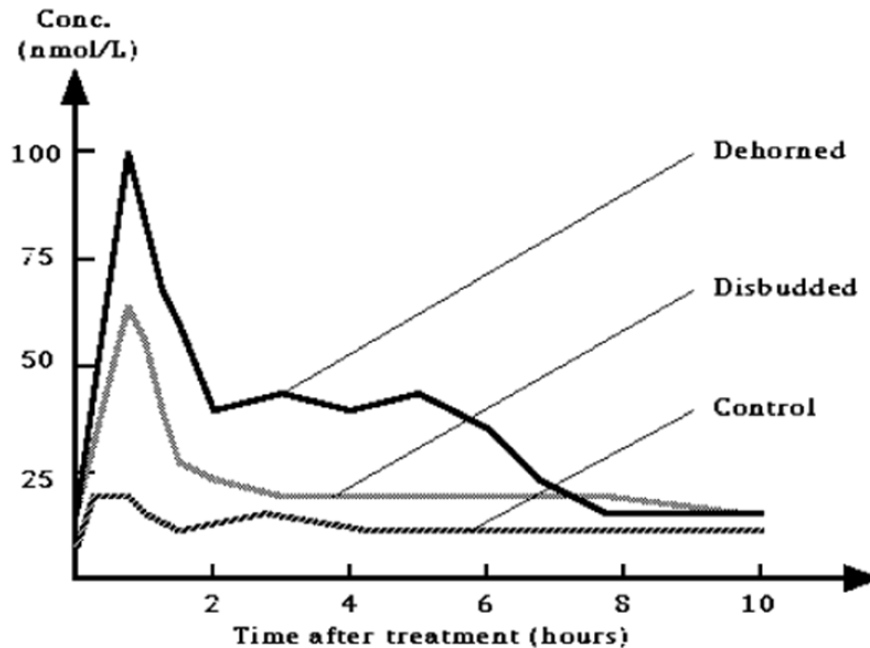


Figure 1-3, Changes in the plasma cortisol concentrations in 6–8 week old calves after amputation dehorning, cautery disbudding or control treatments (derived from Petrie, 1996) (Stafford 2005)

Blood leukograms have also been used to evaluate acute pain responses in cattle dehorned cattle. Unique to cattle and most other ruminant species is that there is a higher concentration of lymphocytes compared to neutrophils and the normal neutrophil to lymphocyte ratio is approximately 0.5:1 (Merck, 2011). In animals that are undergoing an endogenous corticosteroid stress will have an increased neutrophil to lymphocyte ratio and generalized leukocytosis is normally seen as well (Merck, 2011). In a recent study it was observed that cattle being dehorned with no analgesia will have a leukocytosis as well as increased neutrophil to lymphocyte ratios that approach 2:1 (Sutherland, 2013).

The evaluation of pain based on behavioral changes used frequently in dehorning trials (Stafford 2005). However the perimeters of what specific behaviors are evaluated can be quite different. For example in a Canadian study looking at the effect of ketoprofen's ability to

alleviate pain from cattle that were being dehorned by hot iron cauterization, behaviors evaluated were head shaking, ear flicking, head rubbing, moving, lying, grooming, vocalization, eating and drinking (Faulkner 1999). In an amputation dehorning study using 6 month old Holstein dairy calves behavioral responses were recorded for head shaking, ear flicking, head rubbing, lying, walking and vocalization as well as rumination, tail flicking, leg to face scratching, neck extending and having head down (Sylvester 2004). Both of these studies evaluated behavior for approximately twenty four hours after the dehorning procedure was administered. By comparing these two studies as well as others it becomes apparent that there are several different behavior parameters that can be evaluated, and it can come to a point where it can be exhaustive to analyze them all.

There have been some studies done in the past that have performance and weight gain as a means to analyze the long term dramatic effects of dehorning in cattle. In an Australian study completed in 1982, four groups of cattle totaling over 400 head were evaluated for weight gain performance (Loxton 1982). It was observed in this study that cattle that were dehorned had a decreased weight gain versus non dehorned cattle over the first six weeks after the procedure, but the difference was no longer noticeable after a year (Loxton 1982). In an Oklahoma State University stocker cattle trial there was a performance trend observed between dehorned and non-dehorned cattle, where the dehorned calves gained .054 kgs less per day over a 78 day period (Smith 1996).

Incentives

Dehorning is performed in cattle for the safety of the cattle, the safety of the cattle handlers, more room for cattle at the bunk to eat and reduces the amount of carcass bruising that is present at the time of slaughter (Stafford 2009). Of these reasons to dehorn, by far the most

researched is carcass bruising that is observed in horned cattle. Bruising or contusions on the carcass of an animal meant for human consumption is a public health hazard due to the ability to act as a medium and vehicle for organisms that are infectious pathogens (Marshall 1977). Also the loss of trim due carcass bruising can become a significant economic loss to the cattle owner upon harvest (Marshall 1977). In an Australian study done in the 1970's it was shown that horned and tipped horn cattle in route to an abattoir had up to twice the amount of carcass bruising versus polled cattle, the increase in carcass bruising was also dependent on the number of stops in the route (Ramsay 1976). It was noted in another study that there was no benefit to tipping the horns of cattle versus horned cattle in terms of recorded carcass bruising (Wythes 1979).

There are also direct marketing incentives for younger cattle that are being sold as stocker and feeder calves, as well as benefits in terms of carcass bruising. In a study of Arkansas regional auction sale barns in 2005 horned cattle received discounts of \$3.70 per 45.45 kilograms (100 lbs.) versus non-horned cattle (Barham 2007).

Perceptions

Due to the recent scandals that have surfaced over the last five years, most notably the incident that occurred at the Hallmark Meat Packing Company in California, there has been a renewed interest in the animal welfare debate and more scrutiny has been placed on the practices that are used in modern food animal production systems. Dehorning falls under this list of practices. Surveys of veterinarians can be utilized to see how practitioners' attitudes towards painful procedures and pain management change over time (Fajt 2011). Surveys of different professions that are entwined with livestock production and their perceived hot button issues in animal welfare can allow for better understanding of where their differing opinions lie (Phillips 2009).

An Australian animal welfare survey was conducted in 2009, in which participants included veterinarians, producers, animal scientist, livestock transport representatives, meat processors, government representatives and animal welfare advocacy group representatives (Animals Australia and Royal Society for the Prevent of Cruelty to Animals (RSPCA)) (Phillips 2009). Participants in the study were asked to rank different practices associated with animal welfare in beef cattle production according to their level importance. Dehorning ranked fifth overall by all survey takers, however dehorning was ranked as the highest priority by survey participants that were members of the animal welfare advocate groups, out ranking procedures such as spaying, pre-slaughter stunning, transportation, identification (i.e. branding/tagging) and confinement (Phillips 2009).

In a 2007 survey that consisted of American Association of Bovine Practitioners (AABP) members questions were asked about the degree of pain on scale of 1 to 10, with 1 being associated with no pain and 10 being associated with extreme pain, that was associated with practices in bovine veterinary medicine (Fajt 2011). Questions that asked about the pain of dehorning procedures were divided among age (<6 mo. and >6 mo.) and breed type (beef and dairy). The questions were broken down by age, gender and the life background of the practitioners. Dehorning was perceived as being more painful in older beef and dairy (>6 mo.) calves versus the younger by approximately 1 comparatively on the 1-10 scale, beef calves less than 6 months score a 5.9 and the greater than 6 months beef calves scored 7.0. This increase in perceived pain in the older calves accounted for an 15% increase, 50.9% up from 35.9%, of veterinarians willing to use an analgesic of their choice in the older calves (Fajt 2011).

References

1. American Veterinary Medical Association: Welfare Implications of the Dehorning and Disbudding of Cattle. 2011; June 8. Available at: http://www.avma.org/reference/backgrounders/dehorning_cattle_bgnd.asp. Accessed March 22, 2012.
2. Baldridge S L, Coetzee J F, Dritz S S, Reinbold J B, Gehring R, Havel J, Kukanich B (2011). Pharmacokinetics and physiologic effects of intramuscularly administered xylazine hydrochloride-ketamine hydrochloridebutorphanol tartrate alone or in combination with orally administered sodium salicylate on biomarkers of pain in Holstein calves following castration and dehorning. American Journal of Veterinary Research, 72(10), 1305-1317.
3. Barham B L, Troxel T R (2007). Factors affecting the selling price of feeder cattle sold at livestock auctions in 2005. Journal of Animal Science, 85, 434-441.
4. Bengtsson B, Menzel A, Holtenius P, Jacobsson S O (1996). Cryosurgical dehorning of calves: a preliminary study. Veterinary Record, 138(10), 234-237.
5. Callicrate: Dehorning cattle with The Callicrate Bander. Available at: <http://www.nobull.net/bander/SBhornRemoval.htm> Accessed July 5, 2012.
6. Duffield T (2008). Current data on dehorning calves. Proceeding of the AABP Annual Conference, 41, 25-28.
7. Fajt V R, Wagner S A, Norby B (2011). Analgesic drug administration and attitudes about analgesia in cattle among bovine practitioners in the United States. Journal of the American Veterinary Medical Association, 238(6), 755-767.
8. Faulkner P M, Weary D M (2000) Reducing Pain after Dehorning in Dairy Calves. Journal of Dairy Science, 83, 2037-2041.

9. Garry F B (2004). An Overview of Animal Welfare in the U. S. Dairy Industry. *The Bovine Practitioner*, 38(1).
10. Graf B, Senn M (1999). Behavioural and physiological responses of calves to dehorning by heat cauterization with or without local anaesthesia. *Applied Animal Behaviour Science*, 62(2), 153-171.
11. Grondahl-Nielsen C, Simonsen H B, Lund J D, Hesselholt M (1999). Behavioural, endocrine and cardiac responses in young calves undergoing dehorning without and with use of sedation and analgesia. *The Veterinary Journal*, 158(1), 14-20.
12. Kihurani D (1989). Healing of Dehorning Wounds. *British Veterinary Journal*, Volume 145(6), 580-585.
13. Klaus-Dieter Budras: Skull with paranasal sinuses and horns. *Bovine Anatomy: An Illustrated Text*, Page 34, ©2003 Schlütersche GmbH & Co. KG, Verlag and Druckerei. Hans-Böckler-Allee 7, 30173 Hanover, Germany
14. Loxton I D (1982). The effect of dehorning Brahman crossbred animals of four age groups on subsequent bodyweight gain. *Australian Veterinary Journal*, 58(5), 191-193
15. Marshall B L (1977). Bruising in cattle presented for slaughter. *New Zealand Veterinary Journal*, 25, 83-86.
16. Merck Veterinary Manual, The: The Leukogram. © 2011; Merck Sharp & Dohme Corp., a subsidiary of Merck & Co., Inc. Whitehouse Station, NJ USA. Available at: <http://www.merckvetmanual.com/mvm/index.jsp?cfile=htm/bc/10705.htm>. Accessed: January 12, 2013

17. Petrie N J, Mellor D J, Stafford K J, Bruce R A, Ward R N (1996). Cortisol responses of calves to two methods of disbudding used with or without local anaesthetic. *New Zealand Veterinary Journal*, 44(1), 4-8
18. Phillips C J C, Wojciechowska J, Meng J, Cross N (2009). Perceptions of the importance of different welfare issues in livestock production. *Animal*, 3(8), 1152-1166.
19. Ramsay W R, Meischke H R, Anderson B (1976). The effect of tipping of horns and interruption of journey on bruising in cattle. *Australian Veterinary Journal*, 52(6), 285-286.
20. Smith S C, Montague M R, Gill D R (1996). Effect of Castration, Dehorning and Body Temperature at Processing on Weight Gain of Newly Received Stocker Cattle. *Animal Science Research Report - Agricultural Experiment Station, Oklahoma State University*, P-951, 214-215.
21. Stafford K J, Mellor D J: Dehorning and Disbudding Distress and its Alleviation in Calves (2005). *The Veterinary Journal*, 169, 337-349.
22. Stafford K J, Mellor D J (2009) Chapter 6: Painful Husbandry Procedures in Livestock and Poultry. *Improving Animal Welfare: A Practical Approach*, 88-114, CABI Publishing
23. Stilwell G, Lima M S, Broom D M (2008). Comparing plasma cortisol and behavior of calves dehorned with caustic paste after non-steroidal-anti-inflammatory analgesia. *Livestock Science*, 119, 63-69.
24. Sutherland M A, Ballou M A, Davis B L, Brooks T A (2013). The effect of castration and dehorning singularly or combined on the behavior and physiology on Holstein calves. *Journal of Animal Science*, Published online before print. doi: 10.2527/jas.2012-5190.

25. Sylvester S P, Stafford K J, Mellor D J, Bruce R A, Ward R N (1998). Acute cortisol responses of calves to four methods of dehorning by amputation. *Australian Veterinary Journal*, 76 (2), 123-126.
26. Sylvester S P, Stafford K J, Mellor D J, Bruce R A, Ward R N (2004). Behavioral responses of calves to amputation dehorning with and without local anesthesia. *Australian Veterinary Journal*, 82(11), 697-700.
27. Vickers K J, Niel L, Kiehlbauch L M, Weary D M (2005). Calf Response to Caustic Paste and Hot-Iron Dehorning Using Sedation with and without Local Anesthetic. *Journal of Dairy Science*, 88, 1454-1459.
28. Wythes J R, Horder J C, Lapworth J W, Cheffins R C (1979). Effect of tipped horns on cattle bruising. *Veterinary Record*, 104(17), 390-392.

Chapter 2 - Comparison of the effects of three different dehorning techniques on behavior and wound healing in feeder cattle in a Western Kansas feedlot.

Introduction

It is a common practice to remove the horns of cattle when they arrive at feeding facilities. Routine animal husbandry techniques such as castration and dehorning have been utilized in dairy and beef production systems to improve the performance of cattle and decrease amount injuries to other cattle and animal handlers (Garry 2004; Stafford 2009). There is a noticeable increase in bruising on the carcasses of cattle that have been housed in pens that had horned cattle in the population (Ramsay 1976, Wythes 1979). Horned feeder cattle that had been marketed in Arkansas regional livestock auction barns received discount averages of \$3.70 per 45.45 kg in 2005 versus polled calves (Barham 2007), giving producers the incentive to dehorn there cattle before marketing them.

Dehorning by amputation or mechanical means is a painful procedure that results in behavioral responses such tail flicking, head shaking and lying with head down (Sylvester 2004). Plasma cortisol levels have been shown to rise above basal levels after dehorning and can remain elevated for up to 9 hours after mechanical dehorning with a Barnes scoop dehorner (Sylvester 1998, Sutherland 2013). Leukocytosis, characterized by an elevated neutrophil to lymphocyte ratio has also been documented in calves 6 hours after dehorning with a Barnes dehorner (Sutherland 2013). In addition to painful distress, there also has been some perceived performance losses and reduction of weight gain associated with these practices (Smith 1996); however, there is Australian research that argues that there is no difference in weight gain between dehorned and control cattle (Loxton 1982). Animal well-being is becoming more of a concern in today's society. Dehorning is a cattle production practice of high concern for beef producers, veterinarians, academics and animal welfare advocates among other animal welfare concerns (Phillips 2009).

There are 3 common techniques utilized in the field to remove or reduce horns in beef cattle. Tipping is the practice of removing the keratinized tip of the horn to the point in which the diameter of the horn is approximately 3 cm and making an effort not to enter the pain sensitive core (Stafford 2009). Dehorning is mechanically removing the horns off at the base of the horn near the head. The use of high tension rubber bands to dehorn cattle has been implemented in cattle feeding facilities. The band cuts off the blood circulation to the horns resulting in avascular necrosis and the horns eventually fall off.

No published reports could be found on the effects of using high tension rubber bands for dehorning on performance or behavior of feeder cattle. Few papers have been published to observe the difference in the different techniques to remove or reduce the horns of beef cattle. This study was conducted to provide some baseline data on behavior, performance and wound healing in cattle dehorned with these common animal husbandry techniques.

Materials and Methods

Forty crossbred, steers and heifers horned beef cattle (BW = 311.9 \pm 4.7 kg) were identified at a commercial feedyard (Dodge City, KS) and used to determine the effects of dehorning methods on wound healing and behavior. The cattle were blocked by weight into 10 blocks of 4 and randomly assigned to 1 of 4 treatments within the blocks (n = 10 animals per treatment): 1) non-dehorned control (CON); 2) banded using a high tension elastic rubber (BAND); 3) mechanically removed (MECH); or 4) tipped horn (TIP). Cattle were moved to a new home pen and were allowed a 14 day acclimation period prior to the treatments being applied.

Cattle were run through the chute on day 0 of the trial and were treated with their assigned procedure. During the dehorning treatments, a vocalization score and information on

chute behavior were recorded. A vocalization score of 0 was assigned when there was no vocalization, 1 for low volume, short-duration (< 1 sec) vocalization and 2 for extended vocalization (>1 sec or greater volume intensity). Cattle were then placed in a feeding pen where all the cattle on the trial were fed together. Cattle were individually weighed on days 0, 7, 14, 21 and 28. Behavioral assessments in cattle for attitude, gait and posture, appetite and lying were observed and recorded daily for 28 days following treatment application. Wound healing and bleeding were observed and recorded over the 28 day period following the treatment application. The scoring was assigned as follows for attitude: 0 = bright, alert, responsive; 1 = quiet but rouses only when pen is approached; 2 = quiet but rouses only when pen was entered; 3 = did not move when pen was entered or had to be touched to get up. Cattle that scored 3 were evaluated by the attending veterinarian and treatment according to diagnosis was applied. Gait and posture were documented; the scoring was as follows: 0 = normal; 1 = reluctant to move, stiff gait; 2 = mild incoordination when stimulated, hunched posture; 3 = obvious ataxia or head tilt, hunching, dragging of one or more limbs. Appetite was documented and scored as follows: 0 = normal, full flank; 1 = slightly hollow flank; 2 = hollow flank; 3 = emaciated. Cattle lying down were documented and scored as follows: 0 = lying normal, head up, ruminating; 1 = lying with head down; 2 = lying with full or partial extension of hind legs; 3 = lying in lateral position. Wound healing or the horn bud was documented and scored as follows: 0 = no wound present (completely healed); 1 = minor redness around the wound; 2 = inflamed around the wound with seepage; 3 = inflamed around the wound with major drainage. When the cattle were brought up to the chute digital pictures were taken to document the healing process of the dehorning wounds. If an animal scored a 3 for wound healing, the wound was cleaned and debrided. If

required, the pen riders or the attending veterinarian prescribed an antibiotic and therapeutic regime.

The data collected daily over the course of the trial was entered into Microsoft Excel 2010™ for each individual animal. The individual vocalization scores were averaged together within the treatment groups and analyzed by Wilcoxon Rank Sum Test of SAS. The individual daily animal scores were averaged together by treatment and also by week for each of the four weeks to assess for treatment by time interactions. The independent variables that were evaluated for treatment by time interaction were attitude, gait and posture, appetite, lying, horn bud and wound healing. Behavior scores were analyzed as repeated measures. Least squares means were considered different with $P < 0.05$ and were considered a trend with $P < 0.10$.

Results

The banding technique success over the 4 week time period was poor to inconclusive during the trial. Four (4/20) of the bands fell off without removing the horn, all of these occurred in the first 4 days of the trial. During the trial only three (3/20) horns that had been banded fell off during a 28 day period, leaving 13 out of the 20 horns at the end of the 4 week trial with the bands still attached to them.

MECH and BAND had greater vocalization scores than either CON or TIP ($P < 0.01$; **Figure 2-1**). Cattle with the MECH treatment had the most extended vocalization, indicating the greatest discomfort during the procedure. The BAND group had lower vocalization scores than the MECH at the time of dehorning. The cattle treated with TIP and CON did not have different vocalization scores and both groups had significantly lower vocalization scores than both the MECH and BAND groups.

There was treatment by time interactions for attitude score ($P < 0.01$; **Figure 2-2**). Cattle from the BAND group tended to have higher attitude scores than cattle in the TIP group in first week, the MECH group in the third week and the CON and MECH in the fourth week ($P < 0.10$); however, there was no differences in the treatment effect over the entire duration of the trial ($P = 0.20$).

The scores for abnormal gait and posture among cattle were similar to the trend seen in the attitude scoring. There was no treatment by time interaction effects for any of the groups ($P = 0.93$; **Figure 2-3**). There was a tendency for cattle in the BAND group to exhibit higher gait and posture scores than cattle in other dehorning treatment groups ($P < 0.10$); these differences in gait and posture due to dehorning methods over the entire duration was significant ($P = 0.03$).

There was effect of the treatment on the appetite of the cattle ($P = 0.01$) and no treatment by time interaction ($P = 0.69$). There was a numerical difference that showed a trend for the BAND group having an increase in appetite score ($P < 0.10$; **Figure 2-4**).

Cattle in BAND had higher lying scores than cattle dehorned with other techniques ($P < 0.01$; **Figure 2-5**). BAND cattle trended higher lying score differences versus cattle dehorned with other methods ($P < .10$). There was no treatment by time interaction effect on the lying scores of the cattle ($P = 0.76$).

There was a treatment by time by interaction ($P < 0.01$; **Figure 2-6**) for hornbud healing. During the first week (D7) there were no differences observed in hornbud healing scores in cattle dehorned with different methods, it was noted that a few individual calves in the MECH group showed signs of increased redness around the dehorn wound and this is represented by a numerical differences. Results during weeks 3 and 4 post-dehorning (D21 and D28) indicate that there was an increased hornbud score for cattle in the BAND group compared to other groups.

During this time in the trial it was noticed that some of the banded horns had started to become loosely attached to the skull and the surround skin became inflamed. It was also noted that during this period three of the twenty banded horns became detached.

There was a treatment by time interaction for bleeding score in this trial ($P < 0.01$; **Figure 2-7**). During the first week post-dehorning, there was no difference in bleeding score in cattle regardless of dehorning method utilized. During the third week (D21) of the trial there was a significant difference observed for wound bleeding in the BAND group of the cattle ($P < 0.05$). This was during the time period where three of the twenty banded horns were detached, these dehorn wounds and some of the horns that were still attached were observed bleeding.

Discussion

Based on increased evidence of treatment effects on abnormal gait and posture ($P = 0.03$), appetite ($P = 0.01$) and abnormal lying ($P < 0.01$), as well as treatment by time effects on attitude depression ($P < 0.01$), inflammation (hornbud) ($P < 0.01$) and bleeding ($P < 0.01$) observed in the latter weeks of the trial, banding appears to be a relatively painful process that has lasting effects. This opposed to the mechanical method which had more observable effects on day 0 or the day of the treatment. Mechanical dehorning resulted in increases in vocalization ($P < 0.01$) at the time of the procedure, which can be associated with an increase in a pain response; this compliments previous research trials which found similar behavioral responses initially seen in mechanical amputation (Sylvester 2004). Tipping the horns had the least amount of pain associated behavior observed throughout the trial and was similar to the control group based on the evaluation of vocalization, attitude, gait and posture, lying, hornbud and bleeding. No difference was detected in performance between the different dehorning procedures ($P = 0.81$), this is supported by some prior Australian research (Loxton, 1982).

From an economical perspective of the prices of the instruments used in the process, initial cost of the banding instruments for BAND were substantially higher. The price of the rubber bands were approximately \$2.50 a band or \$5.00 per head (Valley Vet Supply, Marysville, KS), and the Callicrate Smart Bander Castrator, No-Bull Enterprises, Inc., Saint Francis, KS cost \$249.95 (Valley Vet Supply, Marysville, KS). The Convex Dehorner used for MECH cost \$154.99 (Valley Vet Supply, Marysville, KS) and the Searing Iron cauterizer cost \$63.95 (Valley Vet Supply, Marysville, KS). The Ace Compound Action Bypass Lopper cost \$34.99 (Ace Hardware, Oak Brook, Illinois); it was used for the TIP group.

Upon the completion of the trial it was concluded that the biggest limitation to this study was the total number of head that were enrolled in the trail. It was a challenge to put together a group of calves that were all of a consistent weight and had similar sizes of horns. With the behavioral traits observed in mind, coupled with the price of the instruments used and the reduced efficacy of the high tension band treatment (three of twenty horns removed over the course of the four week trial), it is our recommendation that the using bands to dehorn calves is not a more humane alternative to mechanical dehorning. It is noted that tipping resulted in the least amount of observable pain in the animals; however based on previous research (Wythes 1979, Ramsay 1976) the advantages of dehorning cattle are debatable from a carcass bruising perspective. It would be necessary to engage in further study and research to evaluate other methods of dehorning and the combination use of analgesics and nerve blocking, as well as breed effects and differences in horn size and structure.

References

1. Barham B L, Troxel T R (2007). Factors affecting the selling price of feeder cattle sold at livestock auctions in 2005. *Journal of Animal Science*, 85, 3434-3441.
2. Garry F B (2004). An Overview of Animal Welfare in the U. S. Dairy Industry. *The Veterinary Journal*, 38(1).
3. Loxton I D, Toleman M A, Holmes A E (1982). The effect of dehorning Brahman crossbred animals of four age groups on subsequent weight gain. *Australian Veterinary Journal*, 58(5), 191-193.
4. Phillips C J C, Wojciechowska J, Meng J, Cross N (2009). Perceptions of the importance of different welfare issues in livestock production. *Animal*, 3(8), 1152-1166.
5. Ramsay W R, Meischke H R, Anderson B (1976). The effect of tipping of horns and interruption of journey on bruising in cattle. *Australian Veterinary Journal*, 52(6), 285-286.
6. Smith S C, Montague M R, Gill D R (1996). Effect of castration, dehorning and body temperature at processing on weight gain of newly received stocker cattle. *Animal Science Research Report – Agriculture Experiment Station, Oklahoma State University*, (P-951), 214-215.
7. Stafford K J, Mellor D J: Chapter 6: Painful Husbandry Procedures in Livestock and Poultry. *Improving Animal Welfare: A Practical Approach*, Pages 88-114, CABI Publishing: 2009
8. Sutherland M A, Ballou M A, Davis B L, Brooks T A (2013). The effect of castration and dehorning singularly or combined on the behavior and physiology on Holstein calves. *Journal of Animal Science*, Published online before print. doi: 10.2527/jas.2012-5190

9. Sylvester S P, Stafford K J, Mellor D J, Bruce R A, Ward R N (2004). Behavioural responses of calves to amputation dehorning with and without local anaesthesia. Australian Veterinary Journal, 82(11), 697-700.
10. Sylvester S P, Stafford K J, Mellor D J, Bruce R A, Ward R N (1998). Acute cortisol responses of calves to four methods of dehorning by amputation. Australian Veterinary Journal, 76(2), 123-126.
11. Wythes J R, Horder J C, Lapworth J W, Cheffins R C (1979). Effect of tipped horns on cattle bruising. Veterinary Record, 104(17), 390-392.

Figures and Graphs

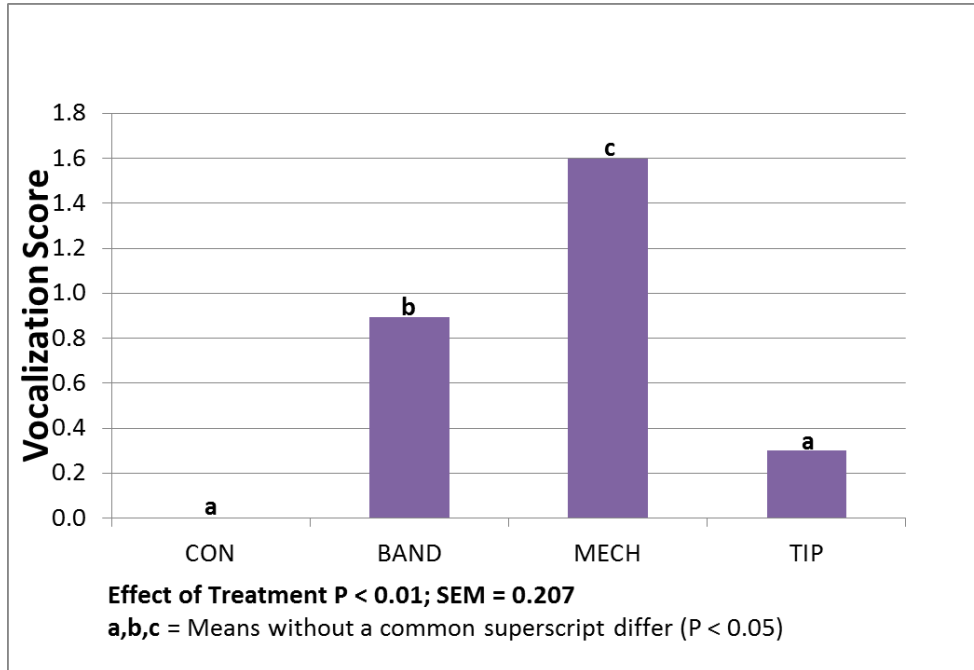


Figure 2-1 The average vocalization scores on the day 0 (day of treatment in the chute) by the treatment that was administered (the main effect of the treatment on the average vocalization score, $P < 0.01$; all means are different except for CON and TIP, $P < 0.05$)

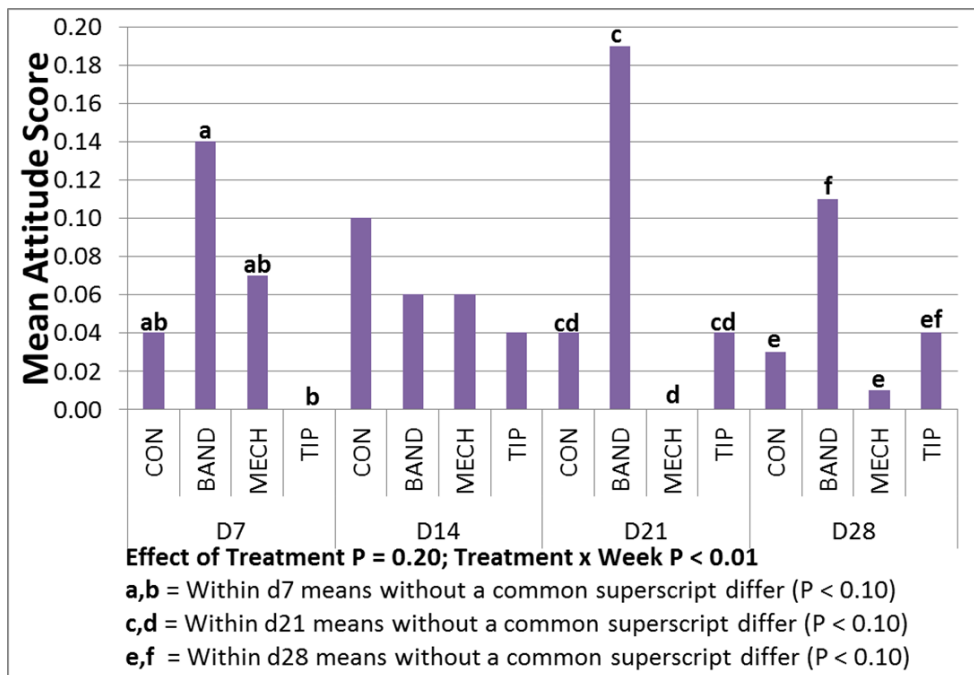


Figure 2-2 The weekly average group attitude score by the treatment of the group (the effect of the treatment by time on the average attitude score, $P < 0.01$; all means are not

different, BAND trends higher versus TIP in the first week, BAND trends higher versus MECH in third week, BAND trends higher versus CON and MECH in the fourth week $P < 0.10$)

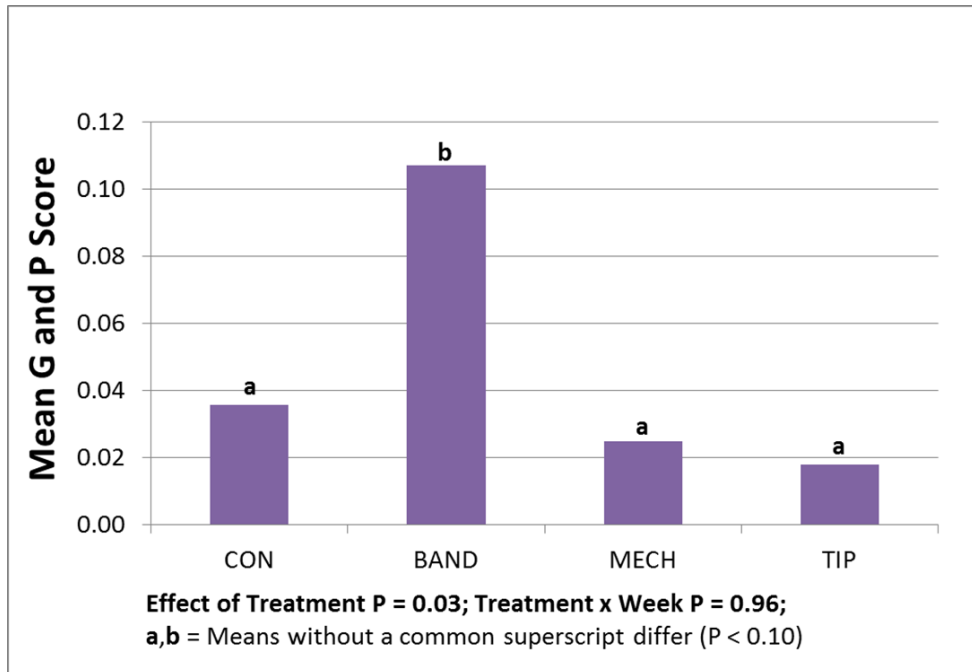


Figure 2-3 The average gait and posture score for the entire duration of the trial by the treatment of the group (the main effect of the treatment on the average gait and posture score, $P = 0.03$; all means are not different, BAND trends higher, $P < 0.10$)

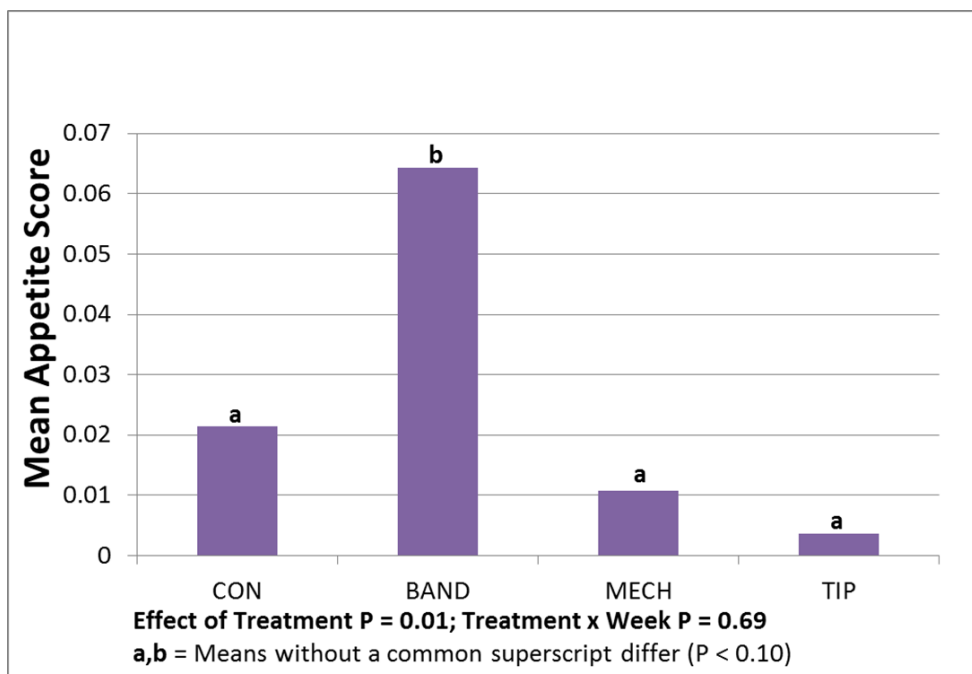


Figure 2-4 The average appetite score for the entire duration of the trial by the treatment of the group (the main effect of the treatment on the average depression, $P = 0.01$; all means are not different, BAND trends higher, $P > 0.10$)

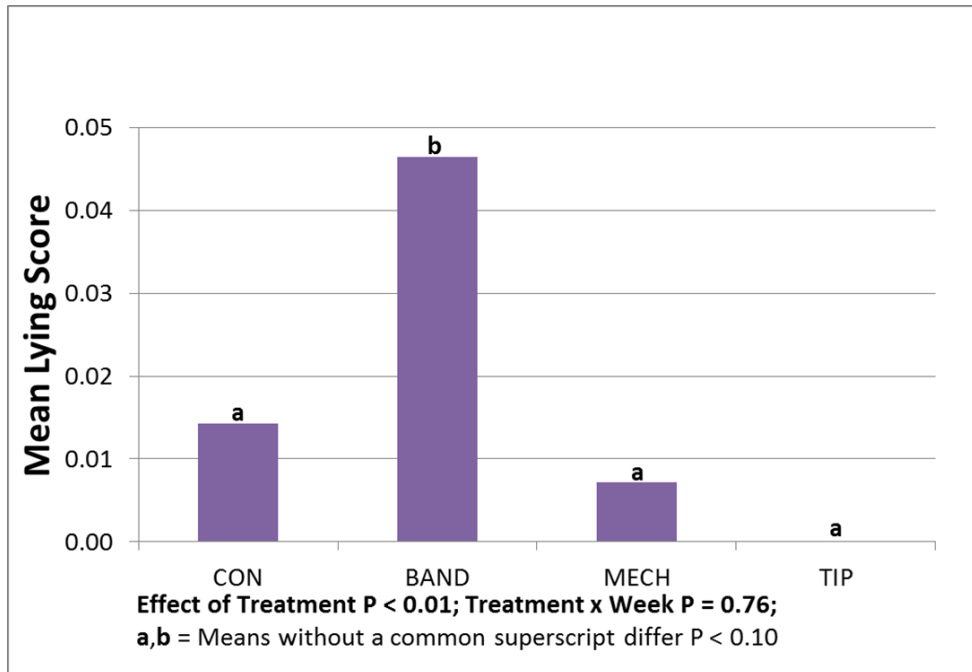


Figure 2-5 The average lying score for the entire duration of the trial by the treatment of the group (the main effect of the treatment on the average lying score, $P < 0.01$; all means are not different, BAND trends higher, $P < 0.10$)

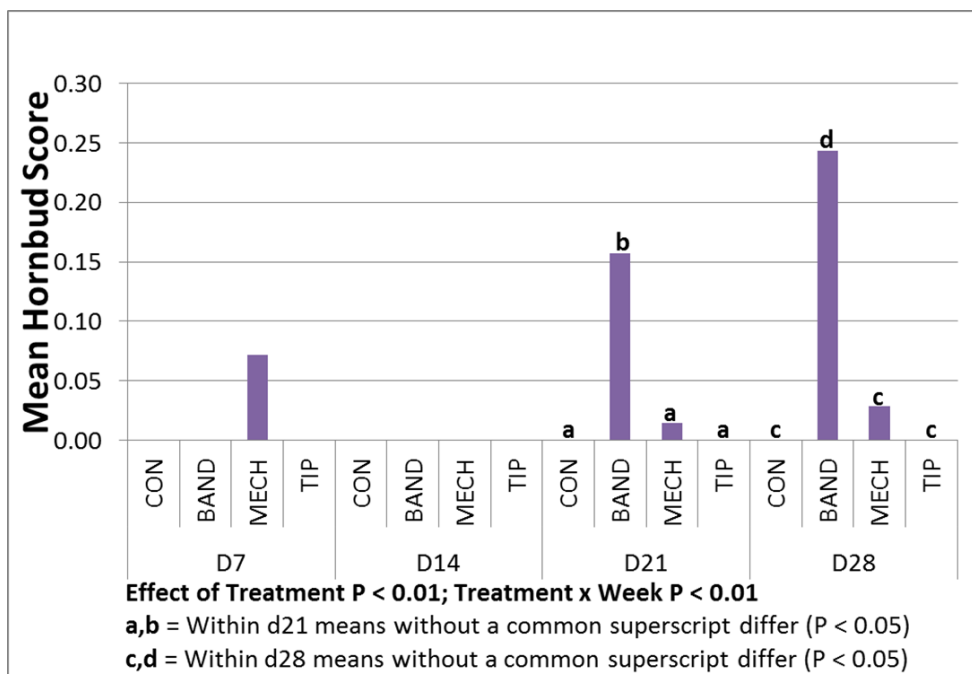


Figure 2-6 The weekly average group hornbud score by the treatment of the group (the effect of the treatment by time on the average bleeding score, $P < 0.01$; all means are not different except BAND in the third week, $P < 0.05$)

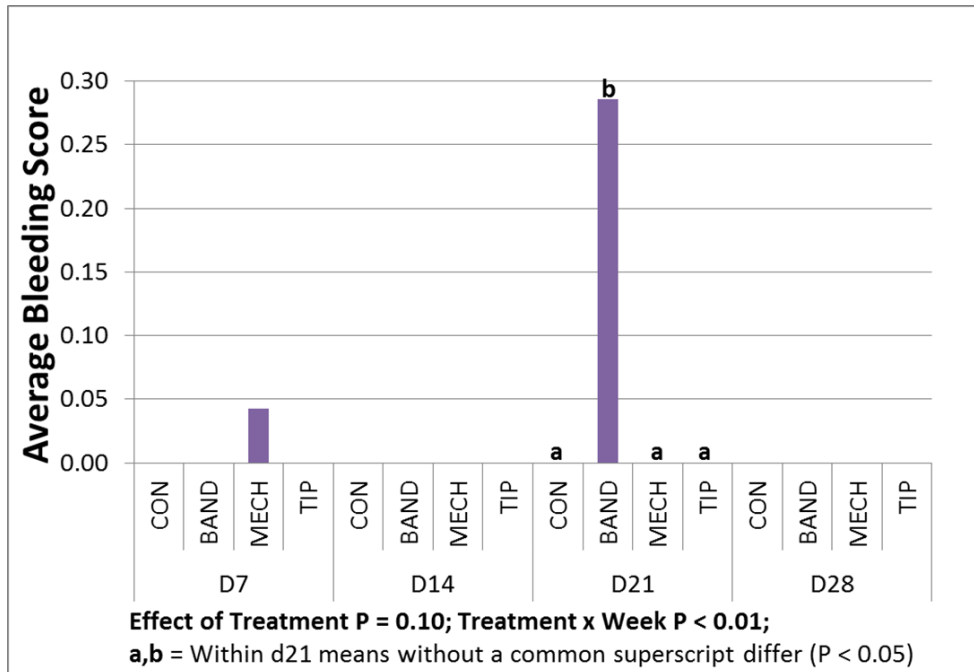


Figure 2-7 The weekly average group bleeding score by the treatment of the group (the effect of the treatment by time on the average bleeding score, $P < 0.01$; all means are not different except BAND in the third week, $P < 0.05$)